Design and development of anti-fouling eco-friendly coatings for marine applications

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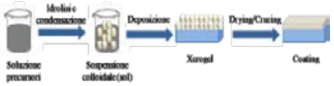
Background

• Traditional paints contain powerful biocides to carry out an antifouling action ("antifouling") based on various organ-compounds of tin, copper, etc. highly toxic to the marine environment. Therefore they are subject to heavy legislative limitations and total exclusion from use. In recent decades, growing awareness of the environmental impact of antifouling biocides has led to the development of "greener" fouling prevention methods.

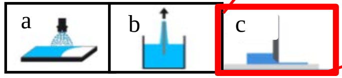
These non-biocidal methods typically aim to prevent fouling by physical or mechanical, rather than chemical (so-called foul release coatings) It is well known that coatings based on suitable silanes provide an efficient approach for hydrophobic and antifouling treatment of surfaces.[1-3]

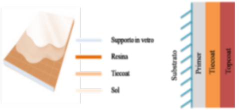
Materials and methods of deposition

• The functional hydrophobic hybrid coatings (topcoats) were deposited on surfaces using sol-gel technology.



APPLICATION
a. Spray
b. Dip Coating
c. Squeegee (doctor blade)





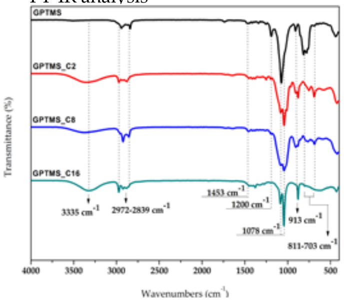
GPTMS(G)
GPTMS/F3 (G/F3)
GPTMS/C16 (G/C16)
GPTMS/C8 (G/C8)
GPTMS/C2(G/C2)

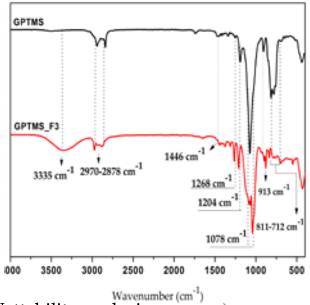
Name	Code
(3-Glycidyloxypropyl) trimethoxysilane	GPTMS
Triethoxy(ethyl)silane	C_2
Triethoxy(octyl)silane	C_8
Hexadecyltrimethoxysilane	C_{16}
3,3,3-Trifluoropropyl-trimethoxysilane	F_3

Results

Characterization of coating

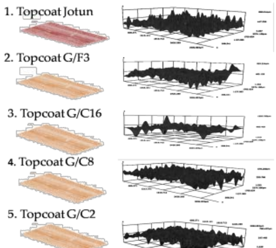
• FT-IR analysis



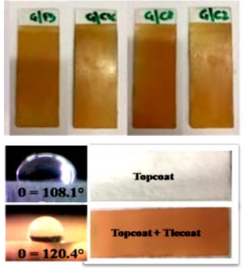


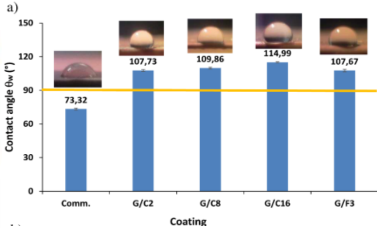
Frequencies (cm^{-1})		Vibrational modes
On the glass	From literature	
3335	3600-3000	ν (O-H)
2972-2839	2980-2800	ν (C-H)
1453	1450	
1268	1263	ν (C-F) in CF_3
1211	1200	ν (Si-O)
1078	1080	ν (Si-O-Si)
913	950	ν (Si-OH)
857-760	816-847	ν (Si-O-Si)
811-703	786-749	ν (Si-O-Si)

• Morphological analysis



• Wettability analysis

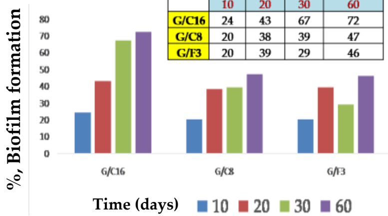


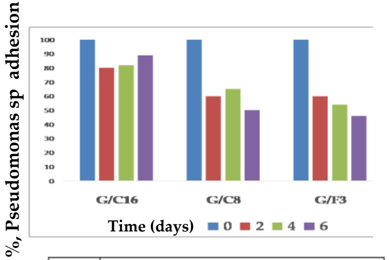


The surfaces pretreated with commercial tiecoat have a higher contact angle with hydrophobic features than those not pretreated (hydrophilic, θ<90°) (see Figure).

• Bacterial adhesion tests and microbiological experiments

	Microbiological colonization (%)			
	10	20	30	60
G/C16	24	43	67	72
G/C8	20	38	39	47
G/F3	20	39	29	46





	Pseudomonas sp. Adhesion (%)			
	0	2	4	6
G/C16	100	80	82	89
G/C8	100	60	65	50
G/F3	100	60	54	46

Conclusion

Functional groups such as long chain alkyl or fluorinated alkyl have a significant influence on surface wettability. Furthermore, the hydrophobic behavior of functionalized coatings has been improved by introducing an intermediate layer of tiecoat between the primer and the topcoat, further increasing the contact angle (CA), decreasing their wettability, and making these coatings more adhesive. compared to commercial coatings of the same chemical nature, therefore ideal for the development of antifouling paints.

Acknowledgement

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References

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